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## ABSTRACT

Drawing on a previous study exploring expertise development in management (J. Arts, W. Gijselaers, and H. Boshuizen, 2000), this study investigated how dimensions of mood may affect recall in studies on expertise development and whether sample composition (distribution of males and females) may account for possible differences in the recall function. A data sample taken from the previous study's data set contained 18 novices, 14 students at the end of the first year of the management program, 22 students at the end of the second year, 15 from the third year, and 16 fourth-year students shortly before graduation. The materials were two cases on organizational development. Results indicate the possibility that gender and mood may affect recall in studies on expertise development. It was also shown that subjects with the same level of expertise may not be treated as replicates. Some of the error variance may be explained by the systematic bias sources of gender and mood. An appendix contains the instrument used in the study and a description of the case studies. (Contains 17 references.) (SLD)

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## Effects of Gender and Mood on Recall in Expertise Research

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## Introduction

Studies in the domain of medicine have shown that expertise development is not simply a process of extending knowledge in existing semantic networks (Schmidt, Norman & Boshuizen, 1990; Patel & Groen, 1991; Schmidt & Boshuizen, 1993). In fact, size of semantic networks is not linearly related to expertise development. But, the relationship between expertise and features of semantic networks is far more complex. It appears that one of the most consistent findings in novice-expert comparisons conducted in the area of medicine, is the so-called intermediate effect. Expert physicians typically recall fewer propositions than intermediate medical students who recall more than novices (Schmidt & Boshuizen, 1993). This phenomenon is defined as the so-called intermediate effect in clinical case representation studies.

Although the intermediate effect in medicine, and other domains of expertise, appears to be very consistent, recent studies by Vaatstra (1996) and van de Wiel (1997) failed to replicate the earlier findings of Schmidt and Boshuizen (1993). In both studies, experts produced significantly more propositions than the student groups (novices and intermediates). For example, Van de Wiel (1997) found in her study a monotone increasing recall function with expertise for four cases in internal medicine. Vaatstra (1996) found a similar phenomenon in the recall function in a study on expertise development in accounting. In both studies it was hypothesized that the failure to replicate the intermediate effect may be explained by case or task difficulty. Basically, these researchers hypothesized that the cases used required elaborate processing of the data even by experts. In turn, the elaborate data processing would

inhibit the use of compiled or encapsulated knowledge, which is usually observed when experts analyze a case. Confirmation for this hypothesis may be found in the cases used by Vaatstra (1996). Her study included lengthy and detailed financial information about managing organizations. Analysis of financial data requires in depth understanding of financial figures to analyze the cases. In addition calculation of new financial indexes is required to arrive at a conclusion. Vaatstra (1996) found differences in application of knowledge, but she didn't find differences in literal recall of the information presented. She concluded that it was not possible to explain from her data why the intermediate effect didn't show. Van de Wiel (1997) tried to develop several alternate hypotheses, next to the task difficulty hypothesis, for the absence of the intermediate effect. But her material didn't allow examining alternate hypotheses. Her final conclusion was that "However, it remains unclear why the experts in the present study elaborately processed the cases" (Van de Wiel 1997, p. 105).

Despite the number and variety of studies demonstrating the intermediate-effect and the consistent patterns of change that have been found in problem-solving as expertise increases, some indications exist that other factors may as well influence literal recall. For example, Balch and Myers (1999) show that in memorizing words, subjects' recall of words may be affected by changes in dimensions of mood (pleasantness and arousal). They assume that mood-item connections are learned between mood and items to be remembered. Recalling items under different mood conditions than learned may then account for reduced recall. An additional factor may be found in the motivation of subjects to analyze the cases given during the experiments. Mayer (1999) points out that in research on development of problem-solving skill, the role of motivational aspects has largely been ignored. According to Mayer (1999), theories

on cognitive motivation predict that learning and development of problem-solving skills depend partly whether students think harder and process the material more deeply when they are interested rather than uninterested.

From a methodological and statistical perspective it is quite surprising to notice that in many studies on expertise development, unlike in other areas of educational research, variability within conditions as additional explanatory factor in recall results has never been further examined. It is generally assumed that subjects within a condition may be considered as replicates. Within condition variability may then be interpreted as measurement of error. This is a distinctly different situation from educational research areas addressing reliability and validity issues of high inferential measures like students' evaluations of university teaching. In this particular domain, many studies show how motivation and background characteristics of subjects may affect ratings of teaching quality (Marsh, 1984).

The present study attempts to examine whether certain background variables affect the results in recall functions in expertise development. This study draws further upon the Arts, Gijsselaers and Boshuizen (2000a) study that explores expertise development in the area of management. Design conditions of that particular study made it possible to conduct some exploratory analyses on whether within condition variability may be explained by certain subject characteristics. In particular attention was paid to how dimensions of mood may affect recall in studies on expertise development and whether sample composition (distribution of males and females) may account for possible differences in the recall function. The present paper examines whether subject-dependent variables (in case mood and gender) affect recall, aims at analyzing within condition variability to find sources of subject bias.

## Method

*Background of the present study.* The present study draws further upon a research project by Arts, Gijsselaers and Boshuizen (2000a) aiming at development of expertise in management sciences. Due to the design of this project it was possible to conduct additional analyses focusing on potential bias sources due to subjects' background characteristics. In particular we were interested in effects of mood on recall and on gender effects on recall.

### *Research questions.*

The first question addressed the issue whether literal recall in expertise studies may be biased by sex differences. Vispoel and Forte Fast (2000) state that "The preponderance of research evidence suggests that sex differences in many educational and psychological domains are actually quite small, have been declining over time, and are more situationally and culturally dependent than sex linked. However, sex differences in some areas still persist." For example, Vispoel and Forte Fast (2000) report that sex differences in self-concept frequently emerge in stereotypical patterns in which men score higher than women in math, problem-solving, whereas women score higher in verbal and artistic domains. These differences appear to be reasonably consistent across age levels. It has also been found that males score higher on standard measures of self-esteem than females, although the differences appear to be small (Kling, Hyde, Showers & Buswell, 1999). Finally, some research on drop-out and success rates within undergraduate college suggests that women have higher success rates on exams, less drop-out and are more intrinsically motivated (Gijsselaers, 1997; Gijsselaers & Ramaeckers, 1990). The first research question in the present study

address the issue whether sex differences may account for within condition variability.

The second question concerned the potential effects of mood on recall. Recent studies on mood-dependent memory show that participants' recall is influenced by mood changes (Eich, Macaulay & Ryan, 1994; Balch, Myers & Papotto, 1999). A typical design for this type of study is that participants learn a set of words under one mood condition, and have to recall them under a different or the same mood condition. There is evidence to suggest that under the changed mood condition, word recall seems to be mediated through mood changes. It is hypothesized that mood changes may be considered as a context-dependent memory effect. That is, if context changes, participants' recall is reduced. This finding fits in theories about effects of context specificity on memory retrieval stating that memory retrieval is partly dependent on environmental cues during encoding information (e.g. Regehr & Norman, 1996).

The present study examines whether mood by itself affects participants' recall. In this respect our study differs from traditional mood studies that examine the effect of mood changes. In this particular study we were interested in the question whether mood during the experiment influences participants' readiness to process a case, which in turn may influence storage and retrieval of information.

Since one of the scopes of the present study was to examine gender effects, a data sample was taken from the Arts, Gijsselaers and Boshuizen (2000) project's data set. This sample excludes the different levels of post-graduate expertise. Note, the post-graduate samples contained for the most part only male subjects. We asked 18 students entering the program (novices), 14 students end of first year program, 22

students (end of second year), 15 students (end of third year), and 16 (fourth year university students, a few months before graduation) in the school of management. Subjects received a small compensation for their participation. Table 1 contains the sample composition.

*Table 1: Distribution of Subjects Between Different Conditions*

	Data Sample					Total
	Novices	End of 1 <sup>st</sup> year	End of 2 <sup>nd</sup> yr	End of 3 <sup>rd</sup> yr	End of 4 <sup>th</sup> yr	
Male	14	10	18	7	12	61
Female	4	4	4	8	4	24
Total	18	14	22	15	16	85

*Procedure.* A standard experimental procedure for expert-novice studies was followed (Patel & Groen, 1991). Subjects were informed that they would get several assignments after they got a text for a limited period of time. Reading time was restricted to .4 seconds per word. In total subjects were allowed 2.15 minutes for Case A, and 2.50 minutes for Case B. The first assignment was that they were asked to write down as much as possible as they could remember. The second assignment asked them to analyze and diagnose the case. Each subject was shown a written description of a management case on organizational development.

*Materials.* The materials consisted of two cases on organizational development. Case A consisted – in the Dutch version – of 339 words, Case B contained – in the Dutch version – 426 words. A translated version of these cases is presented in the Appendix section. The cases were considered to be at the level of intermediate difficulty (end of 4<sup>th</sup> year). Both cases were similar with respect to format and procedure applied during the experiment. These cases were specifically designed for research purposes. Two experts from professional world and two university teachers



worked together with the researchers to develop cases reflecting problem situations graduates may encounter in real-world. Cases were designed to contain a certain amount of case-relevant cues and case-irrelevant cues. A canonical model was developed in advance by this group to identify the number of propositions, relevant and irrelevant propositions, and correct and incorrect inferences and diagnoses.

After offering the first case, subjects were asked to fill in the PANAS Scale, measuring positive and negative affect (Watson, Clark & Tellegen, 1988). PANAS is a validated mood scale, consisting of twenty items measuring positive mood (pleasantness, arousal, etc.) and negative mood (irritable, ashamed, etc.). Subjects were asked to indicate on a five point scale (1= very slightly, 5= extremely) to what extent the feelings described were applicable to them over the past two weeks. After the second case, subjects received the PANAS Scale again. But now we were asking how they felt at the present moment.

*Analysis.* The case texts were segmented in propositions. Propositions consisted of two concepts connected by a qualifier (Kintsch, 1974). Both recall and case analysis protocols were scored against the original case text propositions to compose the recall function. Recall protocols were scored on the count of literal reproductions of the text. Propositions in the recall protocols were classified as case-relevant or case-irrelevant, based on experts' classification.

## **Results and Discussion**

*Free recall.* Figure 1 shows the number of correct propositions recalled by the subjects in the free-recall protocols. Both the results of Case A and Case B are included in figure 1. Results from a two-way Simple Factorial ANOVA (dependent =

amount of recall, factors are level of expertise and gender; Method = Unique) are presented in table 2 (Case A) and table 3 (Case B).

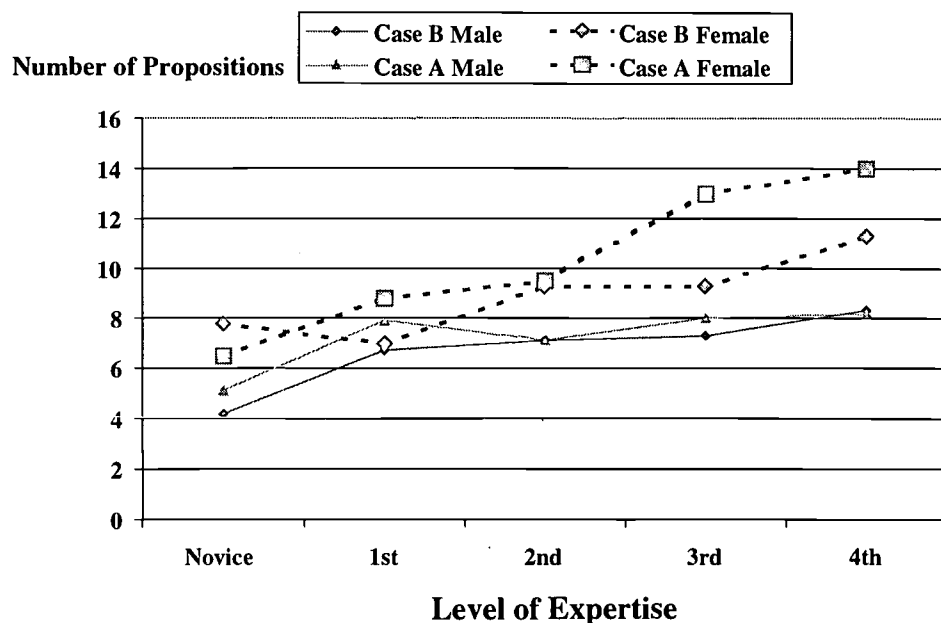


Figure 1: Number of correct propositions recalled

Results show that Male students recalled in Case B [ $F(1,75) = 3.15$ ,  $MS_e = 23.7$ ,  $p < .08$ ] and Case A [ $F(1,75) = 9.87$ ,  $MS_e = 15.5$ ,  $p < .002$ ] significantly fewer information than female students. However, overall differences between level of expertise were only statistically significant for Case A [ $F(4,75) = 3.6$ ,  $MS_e = 15.5$ ,  $p < .009$ ] and not significant for Case B [ $F(4,75) = 1.1$ ,  $MS_e = 23.7$ ,  $p < .36$ ]. No significant two-way interaction effects were found.

Table 2: ANOVA table for Case A

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	499.634	9	55.515	3.573	.001
Intercept	4900.653	1	4900.653	315.441	.000
Level of Expertise	224.797	4	56.199	3.617	.009
Gender	153.342	1	153.342	9.870	.002
Expertise * Gender	60.308	4	15.077	.970	.429
Error	1165.190	75	15.536		
Total	7266.000	85			
Corrected Total	1664.824	84			

Table 3: ANOVA table for Case B

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	259.567	9	28.841	1.217	.298
Intercept	3869.378	1	3869.378	163.212	.000
Level of Expertise	104.114	4	26.029	1.098	.364
Gender	74.670	1	74.670	3.150	.080
Expertise * Gender	17.623	4	4.406	.186	.945
Error	1778.080	75	23.708		
Total	6560.000	85			
Corrected Total	2037.647	84			

This implies that female subjects recall significantly more correct information than male subjects. The results in figure 1 suggest that the largest differences between male and female subjects occur at the intermediate level.

*Recall during problem-solving.* A statistically significant main effect of gender was found for Case A [ $F(1,69) = 6.01$ ,  $MS_e = 8.17$ ,  $p < .017$ ]. In case A female subjects recalled more propositions from text during solving the management case. No significant gender differences were found for case B [ $F(1,65) = 2.66$ ,  $MS_e = 6.62$ ,  $p < .10$ ]. In addition it was found that no differences occur between male and female subjects concerning diagnostic accuracy or amount of inferences.

*Relevant vs. irrelevant recall in recall condition.* In-depth analyses of the recall in the recall condition showed that gender differences occur primarily upon the produced amount of literal correct recall that is relevant to the case. For both cases we found non significant differences for irrelevant recall whereas significant differences were found for relevant recall.

#### *Mood.*

Two dominant effects consistently emerged in the study on the effects of mood on recall. Moderate correlations were found between measures of positive mood (over the past two weeks) and recall in Case A, whereas negative mood (over the past two

weeks) correlated with the number of inferences during the recall assignment of Case A. In addition positive mood at the present moment was positively correlated with inferences in Case A, and nervousness at the present moment was negatively correlated with recall. For Case B substantially less correlations were found for measures of mood and recall measures.

*Table 4: Correlations between Mood, Recall and Inferences*

Mood	Case A Recall	Inferences	Case B Recall	Inferences
<i>Present Moment</i>				
Nervous	-.29*			
Strong		.37*		
<i>Past Two Weeks</i>				
Active	.24*			
Determined				
Jittery		.24*	.243*	
Afraid		.26*		
Upset		.25*		
Irritable		.46*		
Strong		.25*		
Attentive				.26*
Positive Mood	.25*			
Negative Mood		.32*		

N = 71 Subjects, Listwise Deletion

To clarify whether Mood measures were correlated with confounding variables like gender and level of expertise, additional regression analyses were conducted with Number of Inferences Case A as dependent variable, and Measures of Mood and Level of Expertise as independent variables. Tables 5 and 6 provide a summary of this analysis. These tables show that the Negative Mood measure still explains variance of the dependent variable after entering level of expertise. That is, level of expertise explains the largest amount of variance, but Negative Mood (over the past two weeks) explains an additional amount of 3.2% variance.

Table 5: Model Summary

	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					
Model					R Square Change	F Change	df1	df2	Sig. F Change	
1	,699	,489	,482	1,7432	,489	66,013	1	69	,000	
2	,722	,521	,507	1,7002	,032	4,541	1	68	,037	

a Predictors: (Constant), Level of Expertise

b Predictors: (Constant), Level of Expertise, Negative Mood Past Two Weeks

Table 6: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	2.006	.350		5.737	.000		
	Level of Expertise	1.204	.148	.699	8.125	.000	1.000	1.000
2	(Constant)	.656	.719		.913	.365		
	Level of Expertise	1.150	.147	.668	7.838	.000	.970	1.031
	Negative Mood Past Two Weeks	.845	.397	.182	2.131	.037	.970	1.031

a Dependent Variable: Number of Inferences Case A

## Conclusions

The results of the current study are limited to the task environment (Cases A & B), measures we have used (PANAS) and by the properties of the data sample. Despite these limitations, the present study shows the possibility that gender and mood may affect recall results in studies on expertise development. It is possible that recall results may differ depending on sample composition (male – female distribution) and subjects' background characteristics like mood. It is also shown in this study that subjects with the same level of expertise may not be treated as replicates, or that within level of expertise variability is largely due to random error. It looks like some of the error variance may be explained by systematic bias sources (gender and / or mood).

Although in the present study it was never planned in advance to examine bias sources, and therefore the statistical power or the research design was not optimal, it is important to understand how subject characteristics may influence outcome measures like recall. In summary, the present study confirms that recall and amount of inferences (during recall) are related to level of expertise. This result is in line with the majority of research on expertise development. But in addition to the explanatory value of level of expertise, measures of mood and gender are also associated with recall functions. Both variables seem to add on the effects of level of expertise. The gender effect seems to be strongest for the intermediate group. That is, female students produce substantially more propositions than male students in the intermediate condition. At the same time, gender effects were not found for measures describing the process of case analysis (number of correct diagnoses, number of inferences). This outcome may suggest that female students attempt to be more accurate while writing down what they remembered in the recall assignment and analysis assignment. Whether this may be interpreted as a social desirability effect, or motivational effect is unclear (given the available data). This outcome suggests at least that sample composition (female – male distribution) may account for variability within levels of expertise. Since the intermediate effect is always found for subjects just before graduation, the question arises whether the failure to replicate the intermediate effect in some studies may not only be attributed by task difficulty – as hypothesized by researchers like Van de Wiel (1997) - but also by sample composition. Of course, caution is necessary while interpreting the results of the present study due to the limited number of females in our data sample. Arguably, the ideal way to examine possible gendered sources of recall measures is to conduct a longitudinal analysis that examines whether gender differences remain over time.

Another way to examine possible gender effects is to include larger sample sizes and equal division of female and male subjects across level of expertise. Since gender as such doesn't "explain" any other variable, it is important to take variables into account that are as well strongly gender related as theoretically associated to cognitive recall.

The second finding in our study suggests that case processing is also influenced by mood. Traditional studies focused on mood changes as related to recall. The present study focuses on mood as such. Two findings are surprising. First, it is shown that mood as such is moderately correlated with recall. Second, certain mood dimensions are associated with different recall functions (literal recall or inferences during recall). Both findings seem to refer to cognitive processes that facilitate processing, storage and retrieval of cues embedded in the cases. What seems conceptually unexplained is why positive mood influences recall, and negative mood is associated with inferences. This finding is even more peculiar since only case A reveals this pattern. Although these findings seem suggestive, it is important to consider that self-reported positive mood may subjects think harder and process the material more deeply when they are interested or attentive (Mayer, 1999). At the same time, it remains conceptually unclear why negative mood is positively correlated with inferences. It seems that more work must be undertaken before a clear evaluation can be made on the mechanisms between mood and recall measures.

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# Appendix

## The PANAS

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent [INSERT APPROPRIATE TIME INSTRUCTIONS HERE]. Use the following scale to record your answers.

1 Very slightly Or not at all	2 a little	3 moderately	4 quite a bit	5 extremely																				
<table> <tr> <td>Interested</td> <td>Irritable</td> </tr> <tr> <td>Distressed</td> <td>Alert</td> </tr> <tr> <td>Excited</td> <td>Ashamed</td> </tr> <tr> <td>Upset</td> <td>Inspired</td> </tr> <tr> <td>Strong</td> <td>Nervous</td> </tr> <tr> <td>Guilty</td> <td>Determined</td> </tr> <tr> <td>Scared</td> <td>Attentive</td> </tr> <tr> <td>Hostile</td> <td>Jittery</td> </tr> <tr> <td>Enthusiastic</td> <td>Active</td> </tr> <tr> <td>Proud</td> <td>Afraid</td> </tr> </table>					Interested	Irritable	Distressed	Alert	Excited	Ashamed	Upset	Inspired	Strong	Nervous	Guilty	Determined	Scared	Attentive	Hostile	Jittery	Enthusiastic	Active	Proud	Afraid
Interested	Irritable																							
Distressed	Alert																							
Excited	Ashamed																							
Upset	Inspired																							
Strong	Nervous																							
Guilty	Determined																							
Scared	Attentive																							
Hostile	Jittery																							
Enthusiastic	Active																							
Proud	Afraid																							

We have used PANAS with the following time instructions:

Moment (you feel this way right now, that is at the present moment)

Past two weeks (you have felt this way during the past two weeks)

## Cases Used In This Experiment.

### Case A: Flex, Ltd.

Mr. Fox is director and founder of an employment agency (Flex, Ltd.). More than 25 local offices are divided in several regions. Most offices are located in the South of the Netherlands. The state of Zeeland covers more offices than the state of Limburg. Flex showed a remarkable growth: from 70 to 150 employees, sales growing from NLG 15 million to NLG 50 million. Average sales of competitors are about \$ 60 million.

Mr. Fox's desk contains a growing amount of files. Decision-making is getting more and more complex and tiresome. A growing amount of files remain closed. Mr. Fox prefers an informal organization where employees can just drop in his office. Local directors contact Mr. Fox frequently for detailed issues, meanwhile complaining about a lack of central policy making and clear company vision.

Due to the development of new kinds of jobs, Flex decided to specialize. Different offices specialize in different job areas. Offices are specialized in administration, industry, general management and health care. This is unlike in the past when offices covered all job areas. It was not unusual that even physicians and architects became new jobs through the same office of Flex Company.

Local offices are not used to this change. Directors of these offices complain about their job because it is no longer challenging now that they are only targeting at a single profession or a single job area. It shows that local offices are often getting in conflict with other local offices when negotiating with the same company or client. In addition some local offices

initiated their own market research. Clients (companies looking for new personnel) complain that they have to contact different offices for different job specialties. Mr. Fox considers possibilities to improve the performance of Flex. He thinks about splitting company' shares. The accounting department, however, is convinced that Mr. Fox should lower his expenses for public-relations and sponsoring (Mr. Fox considers becoming a sponsor for a tennis-club). The accounting department argues that more money should be allocated to hiring new people for the local offices, or development of a new house-style for the entire organization. The IT-department is convinced that the development of a new financial accounting system provides better and faster information about the company's cash-flow. In addition the write-off period for computers should be reduced to four years.

#### Case B: Crea Ltd.

Miss Jones is looking irritated through a big window. She is not satisfied about the collaborative work at her department. She is now eleven years employed at Crea Ltd. an advertising agency. Her department develops creative advertising ideas for the 'accounts' department. After graduation, Miss Jones started as assistant-manager at the logistics department. A few years ago she became head of the creativity department.

Momentarily she is working on week schedules and setting priorities for her employees. She gives assignments to individual employees. These assignments are more of the same for her employees. In her view efficiency is increased if individuals get assignments they are most experienced with. Miss Jones herself handles jobs requiring coordination and responsibility. Every week she monitors the work of each individual at her department. In her opinion the department is very well managed.

Until recently her department consisted of five employees who immediately after graduation (BA-degree) joined her department. Three months ago new people from another small and very young advertising agency joined her group. This agency employed different working procedures, mainly based on self-regulated teams. Some of these people received a Master degree in History others received Master degrees in communication. Miss Jones is dissatisfied with one of the new employees (Mister Williams). First he didn't want to log his work in a journal, now he has taken initiatives she never asked for. Mister Williams claims he never experienced problems in the past. But now he simply can not find his way in the organization. On behalf of the other new employees he stated that the creativity department would be better off without Miss Jones.

Miss Jones feels insecure about what is happening and considers developing clear-cut working schedules for Mr. Williams. Otherwise she is afraid he may disturb routine procedures in her department. Last month she notified the Director of the company about the case of Mr. Williams. Unfortunately, this week was her first opportunity to discuss it with the director (he was on a business trip to Russia to examine possibilities for partnerships). She claims that the old group of employees didn't have any problems with her. But the director does not agree and introduces the subject of low productivity within her department, and the fact that people left her department. In addition he points to small over-expenditures in her operational budget. According to Miss Jones this may be explained by higher costs for the yearly party with her department. The director (showing a resolute stand) says that Mr. Williams should get a fair chance because he developed some very interesting advertising campaigns in the past. That is the reason why the director hired new people for Miss Jones' department.



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